

## Testimony on House Bill 1459

Mr. Chairman and members of the committee, my name is Dan Laudal and I am a researcher at the University of North Dakota (UND) College of Engineering & Mines (CEM) in Grand Forks. Since late 2015, I have been leading a team of scientists and engineers working to determine the technical and commercial feasibility of producing rare earth elements (REE) from North Dakota lignite coal. My doctoral research involved some of our team's earliest work to understand the chemical association of REE in lignite coals. We have developed a patented and patent pending technology to extract and concentrate REE from lignite coals. Today, my team has constructed and is operating a 500 kg/hour of lignite feed pilot plant in Grand Forks and is completing a front-end engineering & design (FEED) and business planning study. We are optimistic about the commercial potential of this new industry in North Dakota.

First, I want to define my nomenclature: With the term 'rare earth elements (REE)' I mean only the lanthanide series of elements, which are lanthanum through lutetium on the periodic table, and the element yttrium. While our patented technology recovers some other critical minerals as byproducts, our work's primary focus is the REE.

My testimony today aims to provide some brief context on our work at UND CEM as it relates to understanding the practical realities of mining and processing REE associated with lignite coals. From my perspective as someone who has been deeply involved in this work for nearly ten years, it seems unlikely that the REE associated with lignites can be surface mined independently of the lignite coal. This is my opinion, based on key findings from my team's work:

1. The REE have usually been found to be most concentrated in thin layers, typically 3-12 inches, in the top and/or bottom of the lignite coal seams.
2. A majority fraction of the REE are bound in an organic association, as ions chemically bound to the carbon-hydrogen-oxygen structure of the lignite coal. There is no way that we have discovered or that is disclosed in the open literature to separate these organically bound REE from the carbon-hydrogen-oxygen structure of the lignite coal other than through chemical or thermochemical methods. Our technology is tailored to take advantage of the relatively weak binding strength of this organic form of REE.
3. A minority fraction of the REE are bound in an array of discrete mineral forms, such as carbonates and phosphates, that are finely embedded within lignite coal particles or intimately commingled with the lignite coal particles, but not chemically bound to the carbon-hydrogen-oxygen structure of the lignite coal. However, these forms are not targeted by our patented extraction technology as these REE are more expensive to extract.

Given this context, if we are to realize the exciting commercial potential of this new industry in North Dakota, it is essential, in my view, to have legal clarity around the interplay of coal leases and the ownership of REE associated with lignite coals. Having this clarity will provide project developers and investors the certainty needed to build commercial projects, maximizing the potential benefits that North Dakota's natural resources can provide. I thank the sponsors of House Bill 1459 for taking on this task and the committee members for considering it.

I appreciate the opportunity to provide these comments.

Sincerely,

Dan Laudal  
Executive Director, College of Engineering & Mines Research Institute  
Director, Center for Process Engineering Research  
University of North Dakota